INFLUENCE OF A GIN-APPLIED COTTON ADDITIVE ON DUST LEVELS, PROCESSING PERFORMANCE, AND YARN QUALITY

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INFLUENCE OF A GIN-APPLIED COTTON ADDITIVE ON DUST LEVELS, PROCESSING PERFORMANCE, AND YARN QUALITY

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ABSTRACT

Hydrocarbon-base oil was applied to seed cotton in the feed-control system at the gin; one-half of the test cotton received the additive and the remaining cotton received no additive. One-half of the test cotton was processed through two tower driers with no heat applied and the other half through two driers operating at 150° F. One-half of the bales were randomly assigned to "direct" mill processing, and the remaining bales were placed in storage until they were processed approximately 8 months later. The moisture content of lint containing the additive was higher than that of lint with no additive, a difference attributed to the action of the additive in preventing loss of moisture from the fibers. The color quality of lint containing the additive was lower than that of lint with no additive. Lint with the additive produced less card waste and 48 percent less dust in the cardroom than did lint without the additive. Differences in fiber-length, strength, and fineness characteristics of cotton with and without the additive were numerically small and of no practical significance. Generally, strength of yarn spun from cotton with the additive was lower than that of yarn spun from cotton without the additive. Cotton with the additive produced fewer ends down in spinning than did cotton without the additive. Mechanical performance of processing machinery was not adversely affected by the additive. The color quality of lint from cotton subjected to heat drying was generally lower than that of lint from cotton not subjected to heat drying. Opening and picking waste was lower and card waste was higher for cotton that was heat-dried than for cotton that was not heat-dried. There was only a slight reduction in cardroom dust levels when cotton was heat-dried, which was apparently caused by an interaction between the additive and heat drying that nullified the usual effect of heat drying on cardroom dust levels. Yarn spun from heat-dried cotton was weaker, contained more neps, and had a higher irregularity coefficient of variability than yarn spun from cotton that was not heat-dried. Cotton stored before mill processing produced lower cardroom dust levels than did

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cotton processed directly from the gin. Yarn produced from the stored cotton had a higher yarn-appearance index, fewer neps, greater strength, greater elongation, and lower irregularity coefficient of variability than did yarn spun from cotton processed directly from the gin. There were fewer neps in the card web but more ends down during spinning for stored cotton than for cotton processed directly from the gin. Mill-processing performance was affected somewhat by applying the additive at the gin but was no different from that observed while processing cotton to which an additive had been applied at the mill. **KEYWORDS: cotton, cotton additives, dust levels, lint quality, processing performance, yarn quality.**

INTRODUCTION

Cotton dust has been declared a target health hazard by the Occupational Safety and Health Administration (OSHA), because "workers exposed to cotton dust have been known to suffer from a high prevalence of respiratory diseases" (*10*).[4] The Administration further stated, "Byssinosis is a specific respiratory disease, the symptoms of which are attributable to the action of cotton dust on the respiratory passages. The effects of byssinosis can be temporary or permanent, depending upon the exposure and the individual, and can lead in time to chronic obstructive lung disease, primarily chronic bronchitis."

In 1971, OSHA established a standard which limits worker exposure to 1 milligram of cotton dust per cubic meter of air (1 mg/m^3) for an 8-hour time-weighted average as determined by the personal sampler. The standard applies only to workers in textile mills. OSHA's recently proposed change would reduce the standard to 0.2 mg/m^3 of vertical elutriated cotton dust and extend coverage to workers in other segments of the cotton industry, including cotton gins. Utilizing current engineering technology, the estimated cost of compliance with the new standard by cotton gins and textile mills is in excess of $3 billion (*3*). Under the proposed standard, which is based on 1974–75 poundages, estimated total annualized costs per pound of lint will be in excess of 3 cents for gins and 25 cents for textile mills. Over 22 percent of the total annualized costs for textile mills is attributed to energy requirements. These added costs make cotton less attractive to the mill processor and seriously jeopardize cotton's competitive position in the fiber market.

Significant reductions in costs of compliance with the more stringent standard appear possible through development and implementation of new and improved technology for dust control and through methods for reducing the dust potential in cotton delivered to the mill. Certain harvesting and ginning practices affect cardroom dust levels significantly, but reductions in dust levels have not been sufficient to preclude use of air-cleaning systems at the mill (*7*). The application of additives to cotton at the mill as a means for reducing dust levels has produced dramatic results (*5*). Low installation and operating costs associated with an additive application system offer tremendous potential for achieving reduced dust levels at considerable savings over current air-cleaning systems. An added benefit is the significant reduction in energy requirements of the additive system over that of an air-handling system.

Based on the success achieved by using additives in the mill for control of cotton dust, the idea was proposed that additives be applied at some earlier stage in the cotton harvesting-processing sequence. The objective of this study was to determine the effect of an additive applied to seed cotton at the gin on cardroom dust levels, mill-processing performance, and yarn quality. Seed-cotton drying was used as a variable to determine its influence on the ability of the additive to control dust. Bale storage was also included as a variable, since the time period between gin and mill processing and the conditions to which cotton is subjected during storage vary considerably.

[4] Italic numbers in parentheses refer to items in "Literature Cited" at the end of this publication.

METHODS AND MATERIALS

Test Cotton

The cotton for this study was 'Stoneville 213' variety, which was grown near Raymondville, Tex. Approximately 24,500 pounds of seed cotton were harvested from the same field during midday on August 9, 1976, using five two-row spindle-type harvesters. The cotton was loaded directly from the harvesters onto two open-top semitrailers and then fumigated with methyl bromide for 12 hours. (Fumigation is mandatory for interstate shipment of seed cotton produced in Texas to prevent spread of the pink bollworm.) The cotton was then transported in the trailers to the U.S. Cotton Ginning Research Laboratory, Stoneville, Miss., for gin processing.

Gin Processing

Gin processing began on August 16 in the laboratory microgin system (*2*), and the environmental conditions were maintained at 75° F and 55-percent relative humidity. Processing machinery included the feed control, tower drier, 6-cylinder cleaner, stick machine, tower drier, 6-cylinder cleaner, extractor feeder, and 20-saw gin used with two stages of saw-type lint cleaning. The lint cotton was bagged after the second stage of lint cleaning and transported to the full-size gin system for pressing and baling.

The additive used was Texspray,[5] a hydrocarbon-base oil that has long been used as a spindle-moistening agent in harvesting, as a processing aid in ginning, and as a fiber lubricant in the textile mill (*9, 12*). It has also been used in recent studies as a lint overspray to determine its influence on the dust levels generated during mill processing of cotton (*5, 8*). Texspray has a specific gravity of 0.860 and a viscosity of 51 saybolt universal seconds at 100° F, and it is insoluble in water.

The additive was applied as the seed cotton passed through the feed-control system. The application system consisted of an external mixing-atomizing nozzle with required liquid and air-pressure supply lines (fig. 1). The liquid and air-pressure subsystems were monitored with regulators and gages. The additive was stored in a stainless-steel pressurized container and positioned on a scale so that the rate of application (weight of additive per unit of time) could be monitored continuously. The application system was adjusted to achieve an additive level of about 0.3 to 0.5 percent by weight of lint. Additive levels were determined by extraction with Freon TF[6] using the procedure developed by Perkins et al. (*11*). Only one-half of the cotton received the additive.

Two drying levels were used. One-half of the cotton from each treatment condition was processed through the two tower driers with no heat applied, and the other half was processed through the two driers at 150° F. Enough cotton was processed at each gin condition to provide for four replications at the mill. Lot size for mill processing was one-half bale; thus, each bale contained two lots for a total of 32 lots in 16 bales.

Mill Processing

Mill processing was performed at the Cotton Quality Research Station, Clemson, S.C. One-half of the bales from each treatment condition were randomly assigned to mill processing directly from the gin. The remaining bales were

[5] Texaco registered trademark.

[6] Dupont registered trademark.

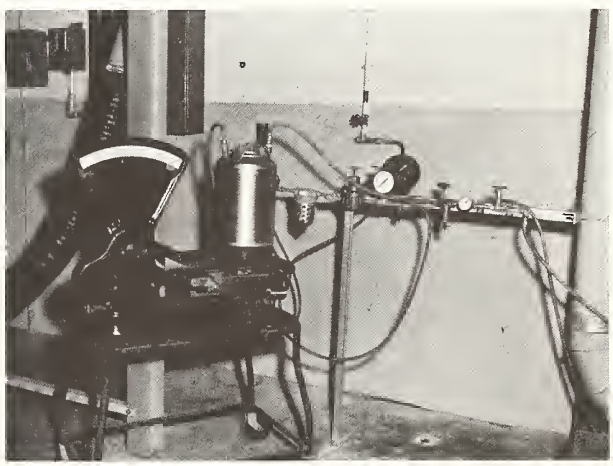

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FIGURE 1.—System for applying additive to seed cotton at the gin.

placed in our cotton-storage warehouse until they were processed about 8 months later. Carding of bales processed "direct" began on September 9, 1976, and was completed on October 10. Carding of bales placed in storage began on April 30, 1977, and was completed on May 12.

All lots were processed through a blender feeder, vertical opener, No. 12 lattice opener, and a two-section one-process picker. Spinning-ends-down tests of 7,056 spindle-hours were conducted for each lot.

The processing parameters were as follows:

Picker	14-ounce lap.
Card	50-grain sliver, 20 pounds/hour.
Breaker drawing	8 ends up, 53-grain sliver.
Finisher drawing	8 ends up, 55-grain sliver.
Roving	1.00 hank, 1.30 twist multiplier.
Ring spinning	40s yarn, 3.89 twist multiplier, 12,000-r/min spindle speed.

Testing

Fiber measurements

Measurements on the fibrograph, Pressley zero-inch and ⅛-inch gages, and on the micronaire for fineness were made on four subsamples of ginned lint from each bale and on one sample of finisher-drawing sliver from each lot. Array tests were made on a composite sample from the four subsamples and on finisher-drawing sliver. Shirley analyzer tests, using ASTM method D 2812–70 (*1*), were made to determine the nonlint content of two 100-gram samples of ginned lint from the bale. Color measurements were made on ginned-lint samples before and after the Shirley analyzer tests. Official classification data were obtained from USDA's Board of Supervisory Cotton Examiners, Memphis, Tenn.

Yarn evaluation

For each test lot, 10 bobbins of yarn from each of the 4 spinning frames (40 bobbins) were tested for skein strength and yarn size. Sixteen bobbins were tested for yarn evenness and imperfections. The sensitivity of the evenness tester was set at 30 percent for thin places and at setting No. 4 for thick places and neps. Yarn from each bobbin was tested at 25 yards per minute for 5 minutes (2,000 yards per lot). The number of imperfections per 1,000 yards was recorded. Single-strand strength tests were made on 40 bobbins, 10 breaks per bobbin. Yarn grade was determined from three yarn boards per spinning lot by three technicians.

TABLE 1.—*Effects of test variables on moisture and trash contents and ginning rates of cottons*[1]

Test variable	Seed-cotton moisture content		Lint moisture at lint slide (pct)	Seed-cotton trash content[2]		Ginning rate (lb/min)
	Wagon (pct)	Feeder apron (pct)		Wagon (pct)	Feeder apron (pct)	
Additive:						
No	8.72	8.60	[3]6.43a	[4]7.19b	[4]3.16b	[3]2.96a
Yes	8.59	8.72	[3]9.01b	[4]6.38a	[4]2.56a	[3]2.57b
Heat-dried:						
No	[3]9.06b	[3]9.09b	7.86	6.63	2.88	2.72
Yes	[3]8.25a	[3]8.24a	7.57	6.94	2.83	2.81
Mill processing:						
Direct	8.57	8.64	7.78	6.81	2.95	2.77
After storage	8.74	8.68	7.65	6.76	2.77	2.76

[1] For mill processing, averages are for bales randomly assigned to direct processing or to storage before processing.

[2] Determined by fractionation method.

[3] Means in the same test-variable category for the same measurement followed by unlike letters are significantly different at the 1-pct level.

[4] Means in the same test-variable category for the same measurement followed by unlike letters are significantly different at the 5-pct level.

Dust sampling

Each test lot was processed through the controlled experimental cardroom (4). The test conditions were as follows: Temperature, 75° F; relative humidity, 55 percent; airflow rate, 550 cubic feet per minute; changes of room air, 11.5 times per hour; and card-production rate, 20 pounds per hour. No continuous cleaning equipment was used on the card. During the test period, dust samples were obtained simultaneously at four locations with a personal sampler used as a fixed sampler and at two locations with a vertical elutriator sampler.

Statistical analysis

An analysis of variance (randomized complete-block design) was used to determine differences in test results for the treatment combinations. The variables were additive and no additive, heat drying and no heat drying, and direct mill processing and after-storage mill processing.

RESULTS AND DISCUSSION

The moisture content at the wagon of the seed cotton used for drying without heat was higher than that of the cotton used for drying with heat (table 1). The seed-cotton moisture contents of both of these cottons at the feeder apron were the same as those of the corresponding cottons at the wagon, indicating that heat drying had no effect on seed-cotton moisture content. Neither was the lint moisture at the lint slide affected by the heat-drying treatment. There were no differences at the feeder apron in the moisture contents of the seed cotton with the additive and the cotton without the additive. However, lint-moisture content was significantly higher for the cotton containing the additive than for the cotton containing no additive. The difference cannot be accounted for by the weight of the additive on the fibers; hence, the difference is attributed to the action of the additive in preventing loss of moisture from fibers. Initial seed-cotton trash content was lower for the cotton that subsequently received an additive than for cotton that did not. However, the percentage reductions in trash content dur-

TABLE 2.—*Effects of test variables on composite grade indices and staple lengths of cottons*[1]

Test variable	Composite grade index	Staple length (32d inch)
Additive:		
No	97.4	33.3
Yes	97.4	33.1
Heat-dried:		
No	97.0	33.3
Yes	97.8	33.1
Mill processing:		
Direct	97.4	33.3
After storage	97.4	33.1

[1] Grade Index: Middling White (31) = 100; Strict Low Middling (41) = 94; Low Middling (51) = 85; Strict Good Ordinary (61) = 76; Good Ordinary (71) = 70. For mill processing, averages are for bales randomly assigned to direct processing or to storage before processing.

TABLE 3.—*Effects of test variables on color values of cottons*

Test variable	Reflectance (R_d)		Degree of yellowness ($+b$)	
	Ginned lint	Cleaned lint	Ginned lint	Cleaned lint
Additive:				
No	[1]75.1a	[1]76.3a	9.6	[2]9.7b
Yes	[1]72.7b	[1]73.9b	9.7	[2]9.9a
Heat-dried:				
No	74.1	[2]75.4a	9.7	9.8
Yes	73.6	[2]74.9b	9.6	9.7
Mill processing:				
Direct	[1]72.0b	[1]73.1b	[1]9.8b	[1]9.9a
After storage	[1]75.8a	[1]77.1a	[1]9.4a	[1]9.6b

[1] Means in the same test-variable category for the same measurement followed by unlike letters are significantly different at the 1-pct level.

[2] Means in the same test-variable category for the same measurement followed by unlike letters are significantly different at the 5-pct level.

TABLE 4.—*Effects of test variables on nonlint contents, opening and picking waste, and card waste of cottons*

Test variable	Total nonlint content[1] (pct)	Opening and picking waste (pct)	Card waste (pct)
Additive:			
No	1.86	0.59	[2]2.25b
Yes	1.65	.58	[2]2.05a
Heat-dried:			
No	1.84	[2].61b	[3]2.12a
Yes	1.66	[2].56a	[3]2.18b
Mill processing:			
Direct	1.82	[2].55a	[2]2.21b
After storage	1.69	[2].62b	[2]2.08a

[1] Samples extracted from bale in opening room.

[2] Means in the same test-variable category for the same measurement followed by unlike letters are significantly different at the 1-pct level.

[3] Means in the same test-variable category for the same measurement followed by unlike letters are significantly different at the 5-pct level.

TABLE 5.—*Effects of test variables on cardroom dust levels*

Test variable	Dust level using— Personal sampler (mg/m^3)	Vertical elutriator sampler (mg/m^3)
Additive:		
No	[1]1.51b	[1]1.27b
Yes	[1].78a	[1].65a
Heat-dried:		
No	1.16	[1].98b
Yes	1.13	[1].93a
Mill processing:		
Direct	[2]1.20b	[1]1.04b
After storage	[2]1.09a	[1].87a

[1] Means in the same test-variable category for the same measurement followed by unlike letters are significantly different at the 1-pct level.

[2] Means in the same test-variable category for the same measurement followed by unlike letters are significantly different at the 5-pct level.

TABLE 6.—*Effects of test-variable combinations on cardroom dust levels*

Test-variable combination	Dust level using— Personal sampler (mg/m^3)	Vertical elutriator sampler (mg/m^3)
Additive × heat-dried:		
No × no	1.57	1.35
No × yes	1.45	1.19
Yes × no	.75	.62
Yes × yes	.81	.67
Additive × mill processing:		
No × direct	1.54	1.37
No × after storage	1.48	1.17
Yes × direct	.86	.72
Yes × after storage	.69	.58
Heat-dried × mill processing:		
No × direct	1.22	1.09
No × after storage	1.11	.88
Yes × direct	1.19	1.00
Yes × after storage	1.07	.86

ing the ginning operation were about the same for both cottons. The ginning rate for cotton with the additive was reduced to about 13 percent below that for cotton without the additive. This difference could not be accounted for by differences in moisture and trash contents.

The test variables had no significant effect on composite grade indices or staple lengths (table 2). Grades averaged about Middling Light Spotted (32) and staple lengths about 33 thirty-seconds of an inch. The reflectance (R_d) of both the ginned lint and cleaned lint (Shirley analyzer lint) was higher and the degree of yellowness ($+b$) lower for cotton without the additive than for cotton with the additive (table 3). The reflectance of cleaned lint from cotton that was not heat-dried was higher than that from cotton that was heat-dried. The reflectance of both the ginned lint and cleaned lint was higher and the degree of yellowness lower for cotton from storage than for cotton that was processed directly from the gin.

Total nonlint content was not significantly affected by the test variables, but it was lower for cotton that contained the additive, cotton that was heat-dried, and cotton from storage (table 4). Opening and picking waste was significantly lower for cotton that was heat-dried and cotton that was processed directly from the gin. Card waste was significantly lower for cotton that contained the additive, cotton that was heat-dried, and cotton that was stored. Although the test variables affected opening and picking waste and card waste significantly, the numerical differences were small and thus are not considered to be of practical significance.

Cotton with the additive produced a significantly lower cardroom dust level than did cotton without the additive (table 5). Dust-level reductions were about 48 percent, as determined by both sampling methods. Seed-cotton heat drying resulted in small but significant reductions in dust levels, as determined by the vertical elutriator sampler. Previous studies have shown that, when used independently, seed-cotton drying and the application of an additive to seed cotton can reduce cardroom dust levels significantly. However, when certain additives are used in combination with seed-cotton drying, further reductions in dust levels are apparently nullified (*6, 8*). The data in table 6 show that heat drying caused slight reductions in dust levels for cotton without the additive and slight increases in dust levels for cotton with the additive. For all treatment conditions, stored cottons produced lower dust levels than did the corresponding direct-processed cotton.

Digital fibrograph results show that fiber-length characteristics were not affected by drying treatment and were either not affected or were improved slightly by application of the additive (table 7). The raw-stock length prop-

(*Continued on page 10.*)

TABLE 7.—*Effects of test variables on 2.5- and 50-pct span lengths and length uniformity of cottons*

Test variable	2.5-pct span length		50-pct span length		Length uniformity	
	Ginned lint (inches)	Finisher drawing (inches)	Ginned lint (inch)	Finisher drawing (inch)	Ginned lint (pct)	Finisher drawing (pct)
Additive:						
No	1.06	[1]1.11b	[2]0.48b	[1]0.58b	[2]45b	[1]53b
Yes	1.06	[1]1.13a	[2].49a	[1].61a	[2]46a	[1]54a
Heat-dried:						
No	1.06	1.12	.49	.60	46	53
Yes	1.06	1.12	.48	.59	46	53
Mill processing:						
Direct	[1]1.04b	1.12	[2].48b	.60	46	53
After storage	[1]1.07a	1.12	[2].49a	.60	46	54

[1] Means in the same test-variable category for the same measurement followed by unlike letters are significantly different at the 1-pct level.

[2] Means in the same test-variable category for the same measurement followed by unlike letters are significantly different at the 5-pct level.

TABLE 8.—*Effects of test variables on Pressley strength measurements and micronaire readings of cottons*

Test variable	Strength, zero-inch gage		Strength, ⅛-inch gage		Micronaire reading	
	Ginned lint (1,000 lb/in²)	Finisher drawing (1,000 lb/in²)	Ginned lint (g/tex)	Finisher drawing (g/tex)	Ginned lint	Finisher drawing
Additive:						
No	[1]76a	72	[1]22.6a	21.0	[2]5.0a	[2]5.0a
Yes	[1]75b	71	[1]21.8b	21.1	[2]5.1b	[2]5.1b
Heat-dried:						
No	75	72	22.5	21.1	5.0	5.0
Yes	76	72	21.9	21.1	5.0	5.0
Mill processing:						
Direct	[2]74b	[2]71b	[2]21.6b	[2]20.6b	5.0	[2]4.9a
After storage	[2]77a	[2]73a	[2]22.8a	[2]21.6a	5.0	[2]5.1b

[1] Means in the same test-variable category for the same measurement followed by unlike letters are significantly different at the 5-pct level.

[2] Means in the same test-variable category for the same measurement followed by unlike letters are significantly different at the 1-pct level.

TABLE 9.—*Effects of test variables on upper-quartile lengths, mean lengths, and coefficients of variability of cottons*

Test variable	Upper-quartile length		Mean length		Coefficient of variability	
	Ginned lint (inches)	Finisher drawing (inches)	Ginned lint (inch)	Finisher drawing (inch)	Ginned lint (pct)	Finisher drawing (pct)
Additive:						
No	1.14	[1]1.16b	0.93	[1]0.94b	31.5	[1]30.5b
Yes	1.15	[1]1.17a	.95	[1].96a	31.0	[1]29.6a
Heat-dried:						
No	1.15	1.16	.94	[1].96a	[2]30.6a	[1]29.7a
Yes	1.15	1.16	.93	[1].95b	[2]31.9b	[1]30.4b
Mill processing:						
Direct	1.15	[1]1.17a	.94	[1].96a	31.4	[1]29.6a
After storage	1.15	[1]1.15b	.94	[1].94b	31.1	[1]30.5b

[1] Means in the same test-variable category for the same measurement followed by unlike letters are significantly different at the 1-pct level.

[2] Means in the same test-variable category for the same measurement followed by unlike letters are significantly different at the 5-pct level.

TABLE 10.—*Effects of test variables on fiber-length distributions of cottons*

Test variable	Fibers less than ½ inch		Fibers ½ to 1 inch		Fibers 1 inch and longer	
	Ginned lint (pct)	Finisher drawing (pct)	Ginned lint (pct)	Finisher drawing (pct)	Ginned lint (pct)	Finisher drawing (pct)
Additive:						
No	[1]9.9b	9.3	40.5	36.9	49.6	[2]53.1b
Yes	[1]9.0a	8.8	40.7	35.1	49.9	[2]56.1a
Heat-dried:						
No	[1]9.0a	8.8	41.7	36.2	49.1	55.1
Yes	[1]9.9b	9.2	39.4	35.9	50.4	54.1
Mill processing:						
Direct	9.8	[2]8.4a	39.0	[2]34.4a	51.2	[2]56.3a
After storage	9.1	[2]9.6b	42.1	[2]37.7b	48.3	[2]52.9b

[1] Means in the same test-variable category for the same measurement followed by unlike letters are significantly different at the 5-pct level.

[2] Means in the same test-variable category for the same measurement followed by unlike letters are significantly different at the 1-pct level.

TABLE 11.—*Effects of test variables on selected yarn properties*

Test variable	Break factor	Strength (g)	Elongation (pct)	Strength coefficient of variability (pct)	Yarn appearance index
Additive:					
No	1,682	[1]176a	[2]6.0a	11.7	[1]94b
Yes	1,666	[1]170b	[2]5.7b	11.4	[1]96a
Heat-dried:					
No	[2]1,696a	[1]176a	5.8	11.6	95
Yes	[2]1,652b	[1]171b	5.8	11.5	95
Mill processing:					
Direct	1,667	[1]166b	[1]5.5b	11.5	[1]93b
After storage	1,681	[1]180a	[1]6.1a	11.6	[1]97a

[1] Means in the same test-variable category for the same measurement followed by unlike letters are significantly different at the 1-pct level.

[2] Means in the same test-variable category for the same measurement followed by unlike letters are significantly different at the 5-pct level.

TABLE 12.—*Effects of test variables on imperfections and irregularity coefficients of variability in yarns*

Test variable	Neps (No./1,000 yd)	Thick places (No./1,000 yd)	Thin places (No./1,000 yd)	Irregularity coefficient of variability (pct)
Additive:				
No	[1]770b	[1]3,064b	[1]5,329b	[1]22.9b
Yes	[1]687a	[1]2,785a	[1]4,928a	[1]22.1a
Heat-dried:				
No	[2]702a	[1]2,852a	[1]5,018a	[1]22.3a
Yes	[2]755b	[1]2,997b	[1]5,240b	[1]22.7b
Mill processing:				
Direct	[1]789b	[1]3,169b	[1]5,361b	[1]33.9b
After storage	[1]668a	[1]2,680a	[1]4,896a	[1]22.2a

[1] Means in the same test-variable category for the same measurement followed by unlike letters are significantly different at the 1-pct level.

[2] Means in the same test-variable category for the same measurement followed by unlike letters are significantly different at the 5-pct level.

erties of the stored cotton were somewhat better than those of the direct-processed cotton. However, all length-characteristic differences were small, and they are probably not practically significant.

Pressley-strength and micronaire results (table 8) and Suter-Webb array results (tables 9 and 10) show slight differences between additive levels, drying levels, and mill-processing levels. Yarn properties were affected significantly by test variables (table 11). Strength and elongation for yarn spun from cotton with the additive were lower and appearance index was higher than for yarn spun from cotton without the additive. The decrease in strength of yarn spun from cotton containing the additive is attributed to reduced cohesion between the fibers rather than to a real reduction in strength of individual fibers (unpublished data). The break factor and strength of yarn spun from cotton that was heat-dried were lower than for yarn spun from cotton that was not heat-dried. Strength, elongation, and appearance index for yarn spun from cotton processed after storage were greater than for yarn spun from cotton processed directly from the gin.

Yarn spun from cotton with the additive had fewer neps per 1,000 yards, fewer thick and thin places, and a lower irregularity coefficient of variability (CV) than did yarn spun from cotton without the additive (table 12). Yarn spun from cotton that was not heat-dried had fewer neps per 1,000 yards, fewer thick and thin places, and a lower irregularity CV than did yarn spun from cotton that was heat-dried. Yarn spun from cotton that was stored before processing also produced lower values for similar measures of evaluation than did the yarn spun from cotton that was processed directly from the gin.

TABLE 13.—*Effects of test variables on nep contents and ends down in spinning*

Test variable	Neps (No./100 in^2 of web)	Ends down (No./1,000 spindle-hours)
Additive:		
No	5	[1]27a
Yes	5	[1]24b
Heat-dried:		
No	5	[2]20a
Yes	5	[2]30b
Mill processing:		
Direct	[2]6b	[2]18a
After storage	[2]4a	[2]33b

[1] Means in the same test-variable category for the same measurement followed by unlike letters are significantly different at the 5-pct level.

[2] Means in the same test-variable category for the same measurement followed by unlike letters are significantly different at the 1-pct level.

Cotton that was stored before processing produced fewer neps in the card web than did cotton that was processed direct (table 13).

Ends down in spinning was affected by all test variables and was significantly lower for cotton containing the additive, cotton that was not heat-dried, and cotton that was processed directly from the gin.

SUMMARY AND CONCLUSIONS

Hydrocarbon-base oil applied to seed cotton in the feed-control system at the gin resulted in a decreased ginning rate. The moisture content of lint with the additive was higher than that of lint without the additive. The difference in moisture content cannot be accounted for by the weight of the additive on the fibers; hence, the difference is attributed to the action of the additive in preventing loss of moisture from the fibers. The color quality of lint with the additive was lower than that of lint without the additive.

Lint with the additive produced less card waste and 48 percent less dust in the cardroom than did lint without the additive. There were differences in fiber-length, strength, and fineness characteristics of cotton with and without the additive; however, numerical differences were small and thus are considered to be of no practical significance. Generally, strength of yarn spun from cotton with the additive was lower than that of yarn spun from cotton without the additive. Cotton with the additive produced fewer ends down in spinning than did cotton without the additive. Mechanical performance of processing machinery was not adversely affected by the additive.

The color quality of lint from seed cotton subjected to heat drying was generally lower than that of lint from cotton not subjected to heat drying. Color quality was also affected somewhat by the additive on the lint, as stated above. Opening and picking waste was lower and card waste was higher for the cotton that was heat-dried than for the cotton that was not heat-dried. There was only a slight reduction in cardroom dust levels when cotton was heat-dried. This was apparently caused by an interaction between the additive and seed-cotton drying that nullified the effect of seed-cotton drying on cardroom dust levels. Generally, drying of seed cotton with heat reduces cardroom dust levels more than does drying without heat. Yarn spun from cotton that was heat-dried was weaker, contained more neps, and had a higher irregularity CV than yarn spun from cotton that was not heat-dried.

Cotton stored before mill processing produced lower cardroom dust levels than did cotton processed directly from the gin. Yarn produced from stored cotton had a higher yarn appearance index, fewer neps, greater strength, greater elongation, and lower irregularity CV than did yarn spun from cotton processed directly from the gin. There were fewer neps in the card web but more ends down during spinning for stored cotton than for cotton processed directly from the gin.

Overall, applying an additive to seed cotton at the gin reduced cardroom dust levels significantly. Some fiber and yarn properties were enhanced by application of the additive, while other properties exhibited a detrimental effect. Mill-processing performance was affected somewhat but was no different from that observed while processing cotton containing an additive that was applied at the mill. Some changes in processing procedures would be required for consistent performance and quality levels. These results should in no way be construed as advocating the use of an additive in the gin for control of dust. Preserving cotton's inherent quality is best achieved by following current recommended practices.

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